Microwave-CVD Diamond Protective Coating For 3D Structured Silicon Microsensors

Hajnalka Kovach Csorbai,[1] Csaba Ducso,[4]
Istvan Barsony,[4] Gyorgy Hars,[3] Erika Kalman[2] and
Peter Deak[4]

[1] Hungarian Academy of Sciences
Chemical Research Center, Institute of Chemistry,
Pusztaszeri ut 59-67.
Budapest 1025
Hungary

[2] Bay Zoltn Foundation for Applied Research
Bay Zoltn Institute for Materials Science and Technology
Fehrvri t 130.
Budapest 1116
Hungary

[3] Budapest University of Technology and Economics
Department of Atomic Physics
Budafoki t 8.
Budapest 1111
Hungary

[4] Research Inst. for Technical Physics and Materials
Science
Thin film and Nanostructures Division
P.O.Box. 49
Budapest 1525
Hungary

Microsensors operate in harsh environment require robust encapsulation in order to fulfil general reliability and life-time requirements. Besides the extra costs involved, the special packaging required often limits sensor sensitivity, or compatibility with the sensing principle. With a properly selected thin film coating, deposited directly on the exposed surface of the sensor-chip, one can extend the operation conditions of the device at a reasonable price. Diamond films exhibit unique mechanical, thermal, optical and electrical properties in combination with excellent chemical stability. The main concern in their use as protective layer in sensors is the need for the formation of pinhole-free surface coating on the typically 3 dimensional structures. In this work we present a multi-step nucleation-deposition MW-CVD process developed for contiguous covering of Si bulk micromachined structures. A correlation between the nucleation rate and the electric field distribution over the 3D surface was established. The pinhole density of the layers was measured by electrochemical method, being the most convenient approach on non-planar surfaces. Conventional alkaline underetching method was used as a reference for quantification. Application of the protective coating was demonstrated on the surface of a Si capacitive pressure sensor chip.